steel quiz

LOOKING FOR A CHALLENGE? *Modern Steel Construction*'s monthly Steel Quiz tests your knowledge of steel design and construction. Most answers can be found in the 2005 *Specification for Structural Steel Buildings*, available as a free download from AISC's web site, **www.aisc.org/2005spec**. Where appropriate, other industry standards are also referenced.

It's all about the AISC *Seismic Provisions* in this month's Steel Quiz, developed by AISC's Steel Solutions Center. Sharpen your pencils and go! You can download a copy of the AISC Seismic Provisions at no charge at www.aisc.org/2005seismic.

1 What limiting width-thickness ratio should be used for a member subjected to axial compression plus flexure?

2 What area is used to check for shear yielding and shear buckling on a round HSS?

3 What is the difference between nominal strength, design strength, and allowable strength?

4 **True/False**: When evaluating an existing steel structure, the available strength of the structural members and connections must be assessed based on the AISC specification that was in effect at the time of the original construction.

5 **True/False:** If a steel building structure is classified as Seismic Design Category C and an *R*-Factor of 3 is used, the design need not comply with the detailing requirements of the AISC *Seismic Provisions*.

6 Can finger shims be used in slip-critical connections?

7 **True/False:** When considering flexural yielding on a W-shape, the available strength is based upon the plastic section modulus (Z_x).

8 Is it permitted to use thermal cutting to make bolt holes?

9 When checking the bearing strength at bolt holes, how are the various bolts in the connection required to be checked, given that edge distances vary?

10 Is a pipe the same thing as a round HSS?

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ANSWERS

1 Design of members for combined forces is covered by Chapter H of the 2005 AISC specification. The axial and flexural design parameters are considered independently and combined per the applicable equation. Thus the applicable limiting width-thickness ratio for uniform compression from Table B4.1 is used in determining P_c , and the applicable limiting width-thickness ratio for flexure from Table B4.1 is used in determining M_c.

2 One-half of the gross area of the round HSS based on the design wall thickness is used in the shear check, which also includes parameters for shear buckling based on the diameter of the HSS. See Section G6 of the 2005 AISC specification for details.

3 Nominal strength is the unreduced strength of a structure or component (without the resistance factor or safety factor applied) determined in accordance with the AISC specification. This is an estimate of the load that would be achieved in laboratory testing. Design strength is the nominal strength multiplied by the resistance factor, used with the LRFD load approach. Allowable strength is the nominal strength divided by the safety factor, used with the ASD load approach.

4 **False**. The available strength of members and connections can be determined from applicable provisions of the current AISC specification. See Appendix 5 of the 2005 specification for evaluation of existing structures.

5 **True**. Table 12.2-1 of ASCE 7-05 permits structural steel buildings in seismic design categories A, B, and C to not be specifically detailed for seismic resistance if an *R*-factor of 3 is used in the design. Steel building structures classified as seismic design category D, E, or F are required by ASCE 7-05 to be detailed per the AISC *Seismic Provisions*. Note also that if *R* is taken greater than 3 in categoires A, B, or C, the structure must be detailed per the AISC *Seismic Provisions*.

6 **Yes.** However, the shims must also meet the faying surface requirements. For finger shims up to ¼ in. in slip-critical connections with standard holes, no reduction is necessary. Above ¼ in. thickness, the slip resistance is reduced to that for short-slotted holes. See Section J3.2 and J3.8 of the 2005 AISC specification for details.

7 **True**. As defined in Section F2.1 of the 2005 AISC specification, the nominal flexural strength for yielding is $M_n = M_p = F_yZ_x$. For those familiar with previous versions of the ASD approach, note that this similar concept of plastic distribution was hidden in the specification, which permitted a 10% increase for compact shapes ($F_b = 0.66F_y$ in lieu of $F_b = 0.60F_y$). This increase was provided assuming that the lower-bound shape factor (Z_x/S_x) for a W-shape is 1.1 (the range is from 1.1 to 1.4, approximately). The 2005 AISC specification permits the use of the actual Z_x for the specific shape.

8 **Yes.** Section M2.5 of the 2005 AISC specification states that "thermally cut holes shall be permitted with a surface roughness profile not exceeding 1,000 µin. (25 µm) as defined in ASME B46.1. Gouges shall not exceed a depth of 1⁄16 in. (2 mm)." Thermally cut is defined as cut with gas, plasma, or laser.

9 For connections, the total bearing resistance is taken as the sum of the bearing resistances of the individual bolts. In other words, the bearing resistance at each individual bolt hole is determined, and the sum of these is used to determine the available strength of the connection for this limit state.

10 As defined in the 2005 AISC specification, an HSS is a hollow structural section, which includes square, rectangular or round shapes produced in accordance with a pipe or tubing product specification. Don't confuse this definition with the actual ASTM specifications for the particular material types. Pipe used for structural steelwork, as defined in Section A3 of the 2005 AISC specification, is ASTM A53 Grade B (F_y = 35 ksi); round HSS is ASTM A500 Grade B (F_y = 42 ksi) or Grade C (F_y = 46 ksi).

Anyone is welcome to submit questions and answers for Steel Quiz. If you are interested in submitting one question or an entire quiz, contact AISC's Steel Solutions Center at 866. ASK.AISC or at **solutions@aisc.org**.

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